Space Weather Technical Forecast

Issued on Monday, 08 August 2022 at 13:04 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further Minor Geomagnetic Storms Likely through midweek. Active fluence Likely later this working week.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with activity at GOES16 mostly within B-class, aside from a minor pair of flares around 07/2306UTC that peaked at C1.6 from the departing AR3072. This was one of up to seven sunspot regions on the disc, with all of these either simple unipolar Hsx groups, else simple bipolar groups of Cao or Bxo. The only growth in any spot group was a new unnumbered Bxo that appeared between AR3071 and AR3074, however this emergence was not capped by flare activity.

The main activity on the disc in the past 24-30 hours has been the movement and potential disappearance of up to four filaments - mainly in the eastern solar hemisphere. In order, these have been: a southeast quadrant filament at 07/1000UTC; a northeast at 07/1200UTC; a larger event at 07/1900UTC that straddled both hemispheres; and finally a small northern solar hemisphere event that straddled the meridian. At the time of writing, there is no clear evidence that any of these have any Earth-bound component, nor can they all be accounted for on imagery, however this is an active area of analysis. No Earth-bound Coronal Mass Ejections (CMEs) are yet in evidence.

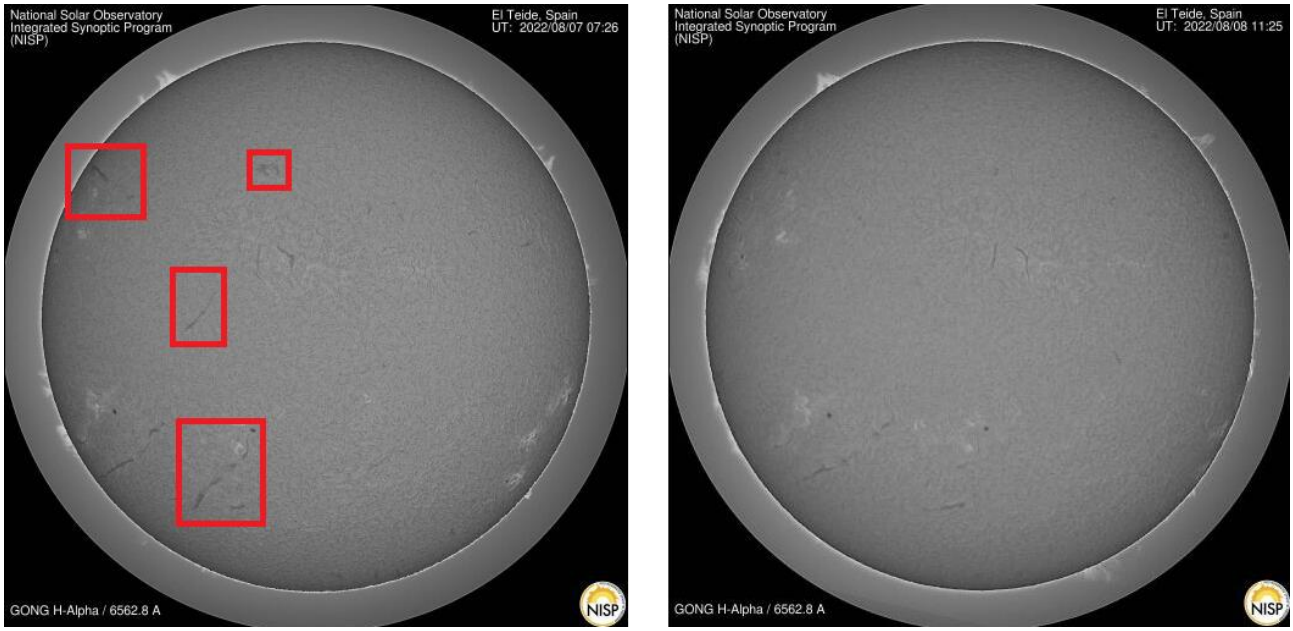

Figure 0a: El Teide H-Alpha imagery of up to four disappearing filaments during and shortly preceding the 24-hour forecast period (before and after disappearance). At the time of writing, none were confirmed as being Earth-directed, but this is under review and not all are accounted for.

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Solar Wind / Geomagnetic Activity: Earth is currently under the influence of the fast wind from a positive polarity coronal hole, with the phi angle accordingly positive (away from the Sun) throughout. The most likely culprit is considered to be CH09 from its westward position on the disc, with CH10 of the same polarity and approaching geoeffectivity.

The solar wind, as measured by DSCOVR and ACE at L1, was characteristic of an elevated fast wind, with the solar wind speed rising from an early 425km/s to reach 550-600km/s from the UTC evening of 07 August. The solar wind density was highest early in the period, with a peak near 15ppcc before waning through the onset of the fast wind regime. The IMF was slightly elevated for much of the period and erratic in character, with a peak near 14nT that finally abated into a more typical range to end the period. The north-south component meanwhile was similarly volatile, with a range of between +11 and -12nT that also gradually lessened.

The net result of the above solar wind measures was a period of heightened geomagnetic activity, with Lerwick magnetometer in particular showing some disturbance, with a roughly 350nT change in the H-component in the 15 minutes following 07/2357UTC. This was less pronounced at magnetometers further south, but did mean two successive intervals of local K7 at Lerwick that straddled midnight UTC.

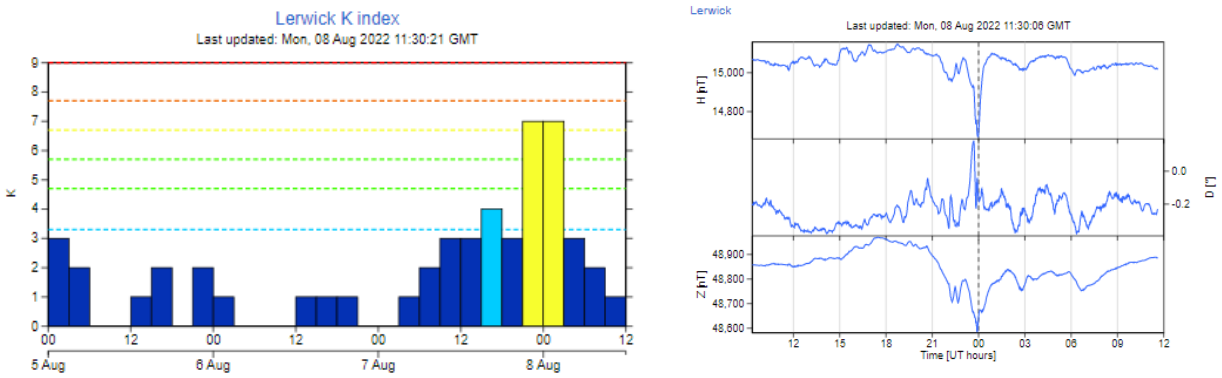

Figure 0b: Lerwick observatory local K and H measurements, showing marked response to onset of (presumably) CH09's high speed stream.

The provisional Kp was Unsettled to Minor Storm G1 throughout, with late revisions in the provisional data giving up to four consecutive G1 intervals 21-09UTC, with the peak being 5o in the 21-24UTC and 00-03UTC intervals.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV), as measured by GOES16, was at Background levels.

The high energy electron flux (greater than 2 MeV) was at Normal Background levels. Electron fluence was well below the Active (1e8 integrated pfu) threshold on a slightly rising trend. 1.74e6 integrated pfu was observed at 08/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low or very low solar activity is forecast, with a decreasing Slight Chance of an isolated M-class flare.

Solar Wind / Geomagnetic Activity: No CMEs feature in the current forecast.

Solar winds are forecast to be elevated - perhaps peaking at strong - due to a succession of high speed streams: firstly CH09/+, and then CH10/+ and perhaps now CH12/+ in turn. CH12 has only

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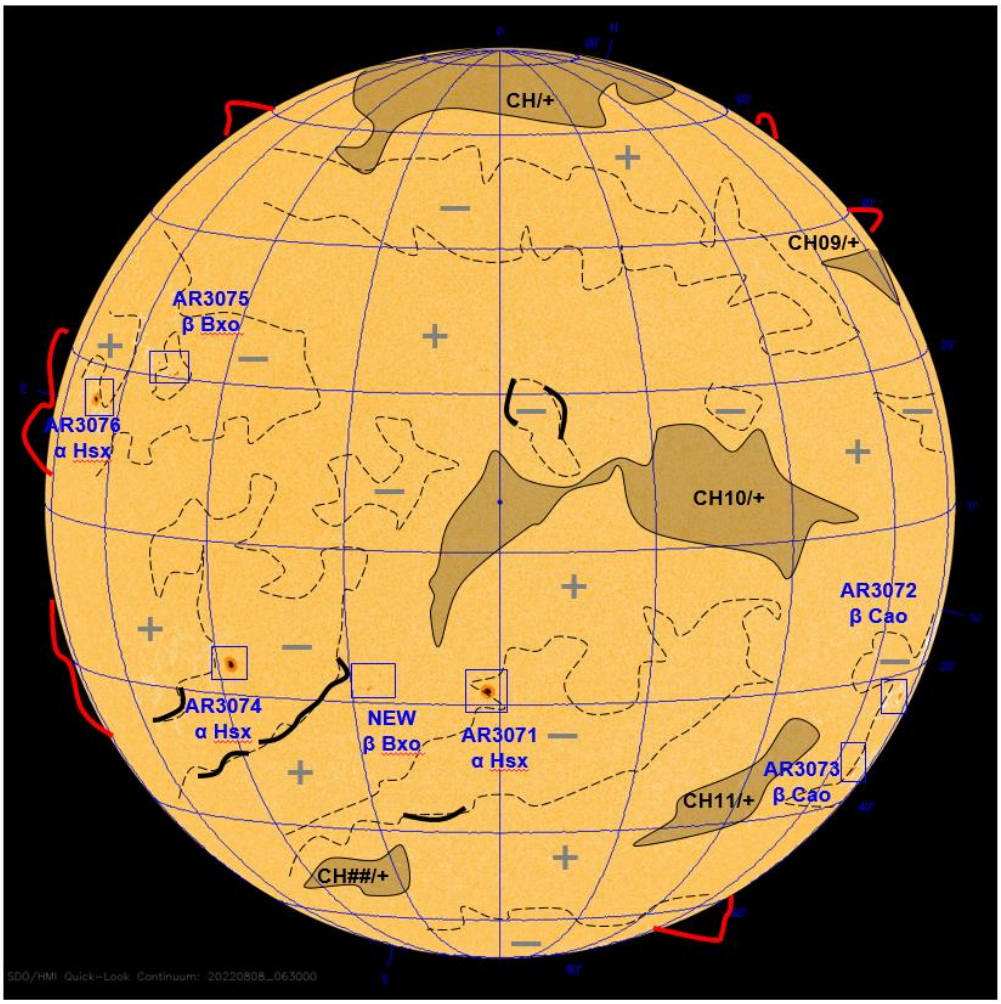
recently appeared and may not manifest at Earth, and in any case transition between all of these features may be indistinct for their all being of the same polarity. Transition between CH09 and CH10 will probably occur later Day 1 (Monday 08 August), or possibly into Day 2.

Geomagnetic activity is now thought Likely to carry a more prolonged risk of G1 through midweek as a result of the succession of CH09, CH10 and now newly-opened CH12. Solar winds may remain slightly elevated later this working week, however the threat of further G1 intervals should recede as the features mature, and Unsettled activity is perhaps more likely by this time.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to remain at Background levels.

The high energy electron flux (greater than 2 MeV) is likely to increase through the period, perhaps peaking at High during the diurnal maxima, but with a question mark given the now more protracted G1 risk through midweek - perhaps acting to suppress count at GEO for a time.
The associated fluence is expected to remain below the Active threshold (1e8 integrated pfu), but with a rising trend, and a chance of reaching Active by Day 4 (Thursday 11 August).

Figure 1. Solar Analysis Valid 08/0630UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No CMEs feature in the current forecast, however there is lower than typical confidence in this continuing, as there have been a number of mobile filaments in recent hours. This is under review.

Solar winds are forecast to be elevated to strong due to a succession of high speed streams: firstly the incumbent CH09/+, and then CH10/+, possibly now followed by newly-numbered CH12. This final coronal hole appears to have developed in the last 36 hours or so, perhaps in part due to the filament activity to its immediate east. CH12 combined with CH10 may now give a more protracted spell at risk of G1, depending on whether there is an intervening lull and CIR or if the features form one continuous longer-lasting fast wind. There is also the question mark of whether these changes have occurred too late to manifest at Earth, as any fast wind emanating from CH12 will have a transit time to 1AU, and there is as yet no sign at STEREO A, two days upwind.

The most notable coronal hole feature of the forecast remains the large coronal hole CH10/+. This is a persistent feature, but larger, darker and more distinct on this rotation. Once the HSS from this feature connects with Earth and the anticipated fast wind arrival, based upon calculation from the leading edge of this feature, would suggest arrival on Day 2 (Tuesday 09 August), however 27-day persistence indicates a slight enhancement during Day 1. Given the more intense appearance of this feature, a faster arrival seems more likely than a slower one, suggesting arrival later this UTC day is most likely. Enlil also has one broad arrival, providing additional confidence for reduced time between CH09 and CH10 fast winds, with solar winds likely being maintained around 550-600 km/s.

Geomagnetic activity is now thought likely to carry a more prolonged risk of G1 through midweek as a result of the succession of CH09, CH10 and now CH12. Solar winds may remain slightly elevated later this working week, however the threat of further G1 should recede as the features mature, and Unsettled activity is perhaps more likely by this time.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	60	60	30	1
Strong	G3	No	10	10	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

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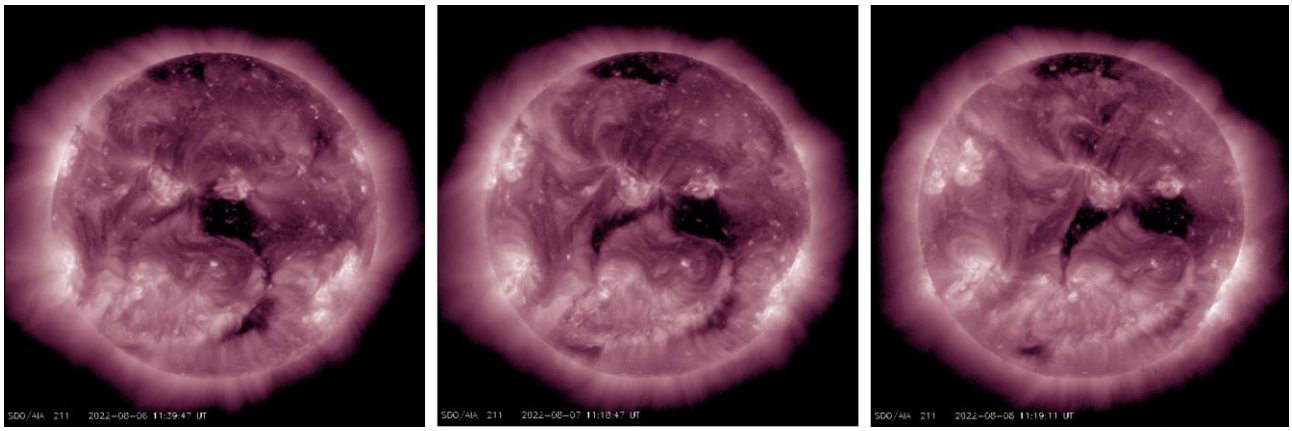
Figure 2: SDO AIA 211 imagery sequence at 24-hour cadence from 11UTC on 06 August, showing graual emergence of CH12 to the immediate east of CH10 – a process that accelerated with the movement of numerous eastern solar hemisphere filaments.



Radio Blackouts - X-Ray Flares:

There are now up to seven sunspot regions on the solar disc, with AR3068 disappearing from view over the western limb, only to be replaced by a minor developing Bxo group further east that has yet to attain a number. Other imminent departures include some of the more visually complex regions on the disc: AR3072 and AR3073, both of which may now be hiding detail as the viewing angle narrows. All of the current disc are otherwise stable and unremarkable, with the front side being the preserve of Hsx, Cao and Bxo groups.

There are hints on STEREO A EUVI 195 imagery of a bright flux region waiting in the wings narrowly over the southeastern limb, however any contribution to flare risk will be assessed as and when this region appears for analysis. The immediate trend in risk should therefore be downward, to be re-assessed with any arrivals.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

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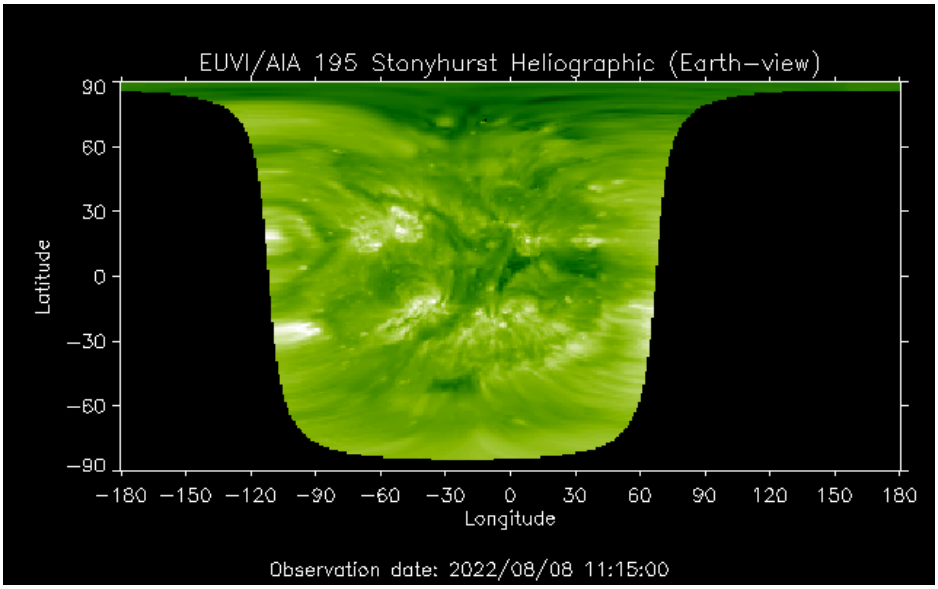
Figure 3: Cylindrical projection of the sun in EUV, showing possible a returning bright flux region that may correspond to a spot group just east of the southeastern limb.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels, and is expected remain at this level through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) as measured by GOES-16, is currently at Background levels.

The geomagnetic forecast is now in a state of flux, with a more protracted risk of G1 now possible given the opening up of CH12. This may serve to dent counts of electrons at GEO, however the upward trend should remain. It is perhaps now likely that High flux should result later this working week UTC, perhaps with interruptions at first before a more sustained tenure by day four, Thursday 11 August.

Active electron fluence is perhaps now Likely on day four, Thursday 11 August, as an eventual result of the successive fast winds of CH09, CH10 and now perhaps also CH12.

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GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^{8}$**	No	5	20	40	60
Very Active	**≥ 2 MeV ≥ $1x10^{9}$**	No	1	1	5	10

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